

Abstract - MESUR Pathfinder Mission Operations Concepts

The Mars Environmental Survey (MESUR) Pathfinder Project plans a December 1996 launch of a single spacecraft. The 7-month cruise includes up to four trajectory correction maneuvers (TCMs) and two checkouts of the complete flight system, one just after launch and one just before arrival at Mars. After jettisoning a cruise stage, an entry body containing a lander and microrover will directly enter the Mars atmosphere and parachute to a hard landing near the sub-solar latitude of 15 degrees North in July 1997. Primary surface operations last for 30 days,

As a Discovery mission, MESUR Pathfinder costs are capped. Cost estimates for Pathfinder ground systems development and operations are not only lower in absolute dollars, but also are a lower percentage of total project costs than in past planetary missions.

Operations teams will be smaller and fewer than typical flight projects. All experiment functions, including rover technology experiments, are collected in one Experiment Team. All engineering functions (exclusive of multimission services) are collected into a single Engineering Team. Operations with two small teams is made possible by the following characteristics:

- Acceptance of more risk as a Class C mission.
- Rover operations using simple high-level behavior commands.
- A simple spin-stabilized flight system.
- Telemetry collection of engineering and experiment data packets by demand into solid state memory.
- Direct-to-Earth telemetry driven only by downlink data rate and independent of collection rate.
- Prioritized packet downlink determined by ground command parameters.
- Onboard management of computer memory.
- No complex navigation data types.
- No cruise science and limited surface experiments.
- Large inheritance from the multimission, workstation-based Ground Data System developed for current JPL projects.

Cruise and surface operations scenarios have been developed early in the project and are being used to guide operations implementation and flight system design. Eight cruise sequence loads are scheduled at approximately 1 month intervals to fit planned checkout and TCM activities.

Recovery of key engineering data from entry, descent, and landing is a top mission priority. These data will be recorded for playback after landing. Real-time tracking of a modified carrier signal through this phase can provide important insight into the spacecraft performance during entry, descent, and landing in the event recorded data is never recovered. Prior to entry, contingency surface sequences will be stored in the lander and microrover for execution in the event landing damage prevents normal operations. These contingency sequences are designed to meet prime mission objectives in a variety of failure scenarios.

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Surface scenarios are dominated by microrover activity and lander imaging during 7 hours of the Mars day from 0700 to 1400 local solar time. Efficient uplink and downlink processes have been designed to command the lander and microrover each Mars day. The design allocates 5 hours for telemetry analysis and 10 hours for sequence generation during each 17-hour Mars night. Commanding each Mars day includes activities to be executed on the current day, plus a projected sequence for the following day. In addition, contingency sequences are updated as necessary each Mars day, depending on activities completed and lander health at the time.